

**FACT SHEET**  
**ON**  
**1,2,3-TRICHLOROPROPANE**

**Identification:**

Chemical Name: 1,2,3-trichloropropane

Regulatory Name: 1,2,3-trichloropropane

Synonyms: allyl trichloride, glycerol trichlorohydrin, glyceryl trichlorohydrin, trichlorohydrin

Formula: C<sub>3</sub>H<sub>5</sub>Cl<sub>3</sub>

DOT Label: **KEEP AWAY FROM FOOD**

CAS: 96-18-4

CHRIS: TCN

UN Number: 2810

**Description:**

1,2,3-trichloropropane is a colorless, heavy liquid. It has been described as having a sweet but strong odor and also as having a strong acrid odor similar to chloroform. 1,2,3-trichloropropane is soluble in alcohol, ether, and chloroform and is slightly soluble in water. It evaporates quickly at ambient temperatures. It dissolves oils, waxes, fats, chlorinated rubber and numerous resins. It is sensitive to prolonged exposure to light and heat. It is reactive with chemically active metals, strong caustics, and oxidizers. When heated to decomposition, it yields highly toxic fumes of carbon monoxide, carbon dioxide, hydrogen chloride gas, phosgene gas, and other chlorinated compounds.

**Fate & Transport:**

- \$ It breaks down in the atmosphere when exposed to sunlight.
- \$ Every 15 days half the amount of 1,2,3-trichloropropane present in the air breaks down.
- \$ It evaporates from surface water and surface soil.
- \$ Very little sticks to soil particles.
- \$ It leaches from deeper soil into the groundwater where it slowly breaks down.
- \$ Evaporation from groundwater is minimal and very slow, so 1,2,3-trichloropropane can remain in groundwater for an extended period of time.

**Exposure Pathways:**

- \$ Breathing low levels in the air
- \$ Drinking low levels in water
- \$ Drinking contaminated well water from wells near hazardous waste sites
- \$ Touching liquids or soil that contain 1,2,3-trichloropropane
- \$ Working in a facility where 1,2,3-trichloropropane is used.

1,2,3-trichloropropane can be measured in blood, urine, and breath. However, it breaks down quickly and leaves the body in breath, urine, and feces. The test cannot measure how much one has been exposed to or whether one's health will be affected. The test requires special equipment not usually available in a doctor's office.

### **Health Effects:**

The main health effect in both animals and people is damage to the respiratory system. Exposure to high levels (100 ppm) of 1,2,3-trichloropropane for a short time can cause central nervous system damage, liver damage and eye, skin and throat irritation. Rats and mice died after breathing air containing 1,2,3-trichloropropane at levels higher than we have in the environment.

When swallowed at high levels, rats died from liver and kidney damage. At moderate nonlethal doses, rats had minor liver and kidney damage, blood disorders and stomach irritation. Animals that swallowed low doses for most of their lives developed tumors in several organs. When applied to the skin of rabbits, 1,2,3-trichloropropane caused severe irritation followed by injury to internal organs.

In the Eighth Report on Carcinogens (1998), 1,2,3-trichloropropane is listed, for the first time, as a substance reasonably anticipated to be a human carcinogen. It is also listed in the Toxic Release Inventory (TRI) as an Occupational Health and Safety Administration (OSHA) carcinogen. However, the Department of Health and Human Services, the Environmental Protection Agency (EPA), and the International Agency for Research on Cancer have not classified 1,2,3-trichloropropane for carcinogenicity.

### **Unknowns:**

- \$ Results for people inhaling low levels for a prolonged period
- \$ Results of skin contact for people
- \$ Results for people swallowing 1,2,3-trichloropropane
- \$ What, if any, damage to people's ability to reproduce after exposure
- \$ Whether birth defects occur after exposure
- \$ Whether 1,2,3-trichloropropane causes cancer in humans.

### **Regulations:**

According to the Agency for Toxic Substances and Disease Registry, the EPA recommends that no more than 2 parts of 1,2,3-trichloropropane per million parts (ppm) of water should be present in water that adults drink over a 7-year period. For children the recommended level is 0.6 ppm. The Occupational Health and Safety Administration (OSHA) has limited workers' exposure to an average of 50 ppm in workplace air for an 8-hour workday, 40-hour workweek.

### **Manufacturers:**

In the U.S., 1,2,3-trichloropropane is manufactured by Dow Chemical USA in Freeport, Texas and Shell Chemical Company in Deer Park, Texas. It is also been produced as a byproduct in the production of other chlorinated compounds, such as dichloropropene, propylene chlorohydrin, dichlorohydrin, glycerol, and epichlorohydrin.

## Release Information:

1,2,3-trichloropropane may be released to the environment as a result of its manufacture, formulation, and use as a solvent and extractive agent, paint and varnish remover, cleaning and degreasing agent, cleaning and maintenance agent, and chemical intermediate. Releases may occur as a result of disposal of products that contain the chemical or through agricultural land use applications of certain soil fumigants that are known to contain 1,2-dichloropropane and 1,2,3-trichloropropane. In these instances, the fumigant was injected into the root zone, after which the soil was compacted to enhance retention of the vapor. Releases may have also occurred through the disposal of 1,2,3-trichloropropane-containing sewage sludge from municipal sewage treatment plants.

## Environmental Fate:

The transformation of pesticides containing 1,3-dichloropropene and chloropropanes to produce breakdown products appears to be much more significant for 1,3-dichloropropene than either 1,2-dichloropropane or 1,2,3-trichloropropane. 1,3-dichloropropene, in the vapor-phase, will react with air, as well as volatilize, biodegrade and hydrolyze in soils and surface waters. It is more likely that any reactions with 1,3-dichloropropene to form additional breakdown products would occur prior to ground water contamination.

However, 1,2,3-trichloropropane will not significantly biodegrade in soils or surface waters, so volatilization into the vapor-phase will occur before either biodegradation or hydrolysis (which is a reaction with water to form a new compound). The vapor pressure of 1,2,3-trichloropropane (3.1 mmHg at 25C), and the calculated Henry's law constant ( $3.17 \times 10^{-5}$  atm-m<sup>3</sup>/mol at 25C) indicates that volatilization from either dry or moist soil to the atmosphere will be a significant environmental process.

Based upon an estimated soil organic carbon partition coefficient ( $K_{oc}$ ) of 98 (calculated from water solubility), 1,2,3-trichloropropane is expected to display high mobility in soil, and therefore it has the potential to leach into groundwater primarily as 1,2,3-trichloropropane. Once 1,2-dichloropropane and 1,2,3-trichloropropane have entered the groundwater, further breakdown products are unlikely since both compounds are resistant to hydrolysis and biodegradation.

1,2,3-trichloropropane is "insoluble" in water, with a solubility of 0.18 gm/100 mL offering further support that it will tend to volatilize versus hydrolyze when in groundwater. This is compared to trichloroethylene (TCE), which is less soluble in water at 0.11 gm/100 mL and tetrachloroethylene (PCE), which is even less soluble in water at 0.015 gm/100 mL. On the other hand, 1,4-dioxane is "miscible" in water and will bond to water molecules compared to sticking to itself in drops or pools in groundwater. Therefore, 1,4-dioxane will tend to stay in groundwater versus tending to volatilize into a vapor in the vadose zone (partially saturated region above the groundwater table) where it can be detected during soil gas sampling.

However, TCE and PCE will tend to volatilize into vapor in the vadose zone, where they'll be detected during soil gas sampling. **Chemical data on 1,2,3-trichloropropane** suggests that it will fall somewhere in between the behavior of 1,4-dioxane and PCE/TCE since it has a

solubility that will allow it to volatilize into a vapor in the vadose zone, and thus should be detected by soil gas sampling, but not as readily as either PCE or TCE.

### **Potential Users:**

The production of chloropropanes (e.g. 1,2-dichloropropane, 1,2,3-trichloropropane, etc) for sale, as opposed to internal consumption as a chemical intermediate by manufactures, was starting to be curtailed by the early 1980's. By 1983, chloropropanes were no longer sold for consumer use (as solvents) in paint strippers, paint varnish, and furniture finish removers and Dow Chemical discontinued production of 1,2-dichloropropane (and 1,2,3-trichloropropane) for agricultural use, such as in fumigant formulations containing chloropropanes, due to the potential for groundwater contamination.

However, pre-1980's, agricultural use of chloropropane containing soil fumigants was prevalent in the United States. Some soil fumigants, which contained a mixture of 1,3-dichloropropene; 1,2-dichloropropane; and 1,2,3-trichloropropane (e.g. D-D) were marketed for the cultivation of a variety of crops including: citrus fruits, pineapple, soya beans, cotton, tomatoes, and potatoes. Before 1978, approximately 55 million pounds/year of 1,3-dichloropropene were produced annually in the United States, of which approximately 20 million additional pounds/year of 1,2-dichloropropane and 1,2,3-trichloropropane were being produced as by-products in the production of 1,3-dichloropropene. Over two million pounds of pesticides containing 1,3-dichloropropene were used in California alone in 1978.

By the early 1980's, approximately 95% of chloropropanes were being used as chemical intermediates. 1,2-dichloropropane was being produced by Dow Chemical for use on-site as an intermediate in the production of perchloroethylene, and similarly, 1,2,3-trichloropropane is currently used as an intermediate in the production of polysulfone liquid polymers, synthesis of hexafluoropropylene, and as a crosslinking agent in the synthesis of polysulfides. The remainder use pattern, by Dow Chemical, for 1,2-dichloropropanes (and possibly 1,2,3-trichloropropane) was 41% in ion exchange manufacturing, 34% in toluene diisocyanate (TDI) production, 19% in photographic film production, 4% in paper coating, and 2% in petroleum catalyst regeneration. Dow Chemical has since phased out its use in TDI production and as a solvent for film production.

Polysulfone liquid polymers are used in the following industries: aerospace, automotive, consumer goods, electrical and electronic, health care, and in industrial equipment, such as compressor and pump valve components. Hexafluoropropylene is a fluorointermediate that is a key building block required to produce Teflon fluoropolymers and has applications in the agrochemical, electronics, dyes/pigments, pharmaceutical, and specialty polymer markets. Polysulfides are used as catalyst sulfidation agents and in the formulation of lubricant additives for extreme pressure functionality.

**Sources:** eco-usa.net; [www.nsc.org/library/chemical](http://www.nsc.org/library/chemical); [www.atsdr.cdc.gov/toxprofiles](http://www.atsdr.cdc.gov/toxprofiles); [www.scorecard.org/chemical-profiles/summary](http://www.scorecard.org/chemical-profiles/summary)